



S03 P 1266 US00

Attorney Docket No. 09792909-5727

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Hirata, K.

Serial No.: 10/705,552

Filed: November 11, 2003

For: SOLID-STATE IMAGING DEVICE AND
METHOD FOR MANUFACTURING THE
SAME

Case No.: 09792909-5727

Examiner: Nguyen, J. H.

Group Art Unit: 2815

Confirmation No. 5105

Certificate of Mailing (37 CFR 1.8(a))

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Roxanne Swartz

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION OF KIYOSHI HIRATA UNDER 37 C.F.R. §1.131

Dear Sir:

1. I, Kiyoshi Hirata, am the sole the inventor of Solid-State Imaging Device and Method for Manufacturing the Same, which is the subject matter of the application for United States Patent Application No. 10/705,552, filed November 11, 2003.

2. United States Patent Application No. 10/705,552 claims priority to Japanese Patent Application No. P2002-330150, filed on November 12, 2002.

3. In the Office Action mailed on April 14, 2005, the Examiner cited as prior art under 35 U.S.C. §102(e) the reference Inagaki (U.S. Pat. No. 6,765,246) to reject pending claims 1-5. The Inagaki reference has a filing date of August 21, 2002, and a prior publication date of May 8, 2003.

4. This is a declaration of prior invention to overcome Inagaki. As inventor of the subject matter of the rejected claims, I hereby submit this declaration to overcome Inagaki.

5. Exhibit A is an English-language translation of an Invention Report that I prepared and submitted to my employer before August 21, 2002 (“Invention Report”), the filing date of Inagaki. A certification of translation is also submitted herewith at Exhibit B. The dates have been redacted from Exhibits A and B.

6. The Invention Report discloses conception of the subject matter of at least claims 1-5 of Application Serial No. 10/705,552. Specifically, the Invention Report discloses a method of manufacturing a solid state imaging device including forming a photosensor in the surface of a substrate (see e.g., page 2 of translated Invention Report, which states that “electric charges, into which received light is photo-electrically converted, are mixed with adjacent pixels . . .”), and forming a channel stop section on the side of the photosensor in the substrate by multiple times of ion implantation with multiple implantation energies (see e.g., page 1 of translated Invention Report, referring to “A channel stop structure in which multiple-stage implantation is carried out . . . by changing energy.”), wherein the ion implantation area and/or the ion concentrations may be changed. (See, e.g., page 1 of Invention Report, items 3 and 4).

7. Japanese Patent Application No. P2002-330150 was filed on November 12, 2002. I declare that between the date of conception and the filing of this Japanese Patent Application, my representatives and I worked reasonably hard and expeditiously to prepare, execute and file the Japanese Patent Application. I reserve the right to show reduction to practice via the Invention Report itself or other acts in addition to the filing of the Japanese Patent Application.

8. I allege that the acts relied upon to establish an invention date prior to the filing date of Inagaki were carried out in Japan.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

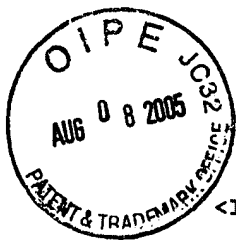
Kiyoshi Hirata
Kiyoshi Hirata

July 24, 2005
Date

Respectfully submitted,

Dated: 8-4-05

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S03P1266

<INVENTION REPORT>

•Proposer Information

[Company Code]	[Inventor Code]	[Proposer Name]	[Belonged Section Name]
000218	100181	Kiyoshi HIRATA	IMNC· PAC· Planning Dept.. Planning

■ Inventor Filling Space ■

[Receipt Number]	02903751	[Date of Receipt]	
[Proposal Number]		[Date of Submission]	
[Title of Invention]	Manufacturing Method of Solid-State Imaging Device		
[Summary of Invention (Invention Department)]	As to a channel stop section which is used for partitioning off a pixel section in a solid-state imaging device, a conventional structure is of the structure that P type impurities are formed by identical energy, whereas in this invention, that structure is changed to another structure that energy is changed and ion implantation is carried out several times, so that it is possible to reduce a smear component which occurs due to a pixel peripheral surface side, and to suppress the color mixture phenomenon that adjacent pixel and photo-electrically converted electric charges are mixed. In addition, by changing an area to which ion implantation is applied with each energy, it is possible to suppress the above-described phenomenon without narrowing a pixel area. It is the invention.		
[Project Name]	01-PJ-108	[Model Number]	0000000
[Model Name/ Development Type Name]			
[Software Classification]		[Development Status]	Development/Trial Production Stage
[Publicity Plan]	No	[Examination Request at the time of Filing (Proposer)]	Desired
[Scheduled Day of Publicity]		[Method of Publicity]	

●Inventor

No	Report Preparation	Inventor Information (Registered)	Inventor Information (Unregistered)	Shared Authentication ID
1	Report Preparation	Company : 000218 Sony Corporation IMNC· PAC· Belonging : NIM409D Planning Dept. Planning Inventor : 100181 Kiyoshi HIRATA Kiyoshi HIRATA E-mail : kiyoshi@shiba.sony.co.jp Tel : (Common to Registered· Unregistered)	Company Name : Belonging Name : e : KANA Name : KANJI Name : E-Mail :	Obtained

●List of Attached Documents

Type	File	Size	Prepared Date	Receipt Number of Combined Child Matter
Inventor Manuscript	Channel stop multiple state implantation.doc	55,296	00:14:14	
Invention Report at the time of Receipt	Invention report at the time of filing.htm	10,781	12:38:57	
Drawing	02903751.tif	438,784	16:24:02	
Check/Correction Material	Channel stop multiple state implantation (revised).doc	47,104	16:38:05	
Others	Modified manuscript.doc	45,568	15:09:37	
	Modification instruction.doc	36,864	15:14:37	

●Prior Art Search

[Search Means] IP-NAVI

●Inventor Comment

Searched by Channel Stop, Multiple Implantation, High Energy, but not found.


Documents to be sent separately


[List of paper documents to be sent separately]

■ Immediate Manager Filling Space ■


[Company Evaluation]	Priority Processing	[Foreign Filing Desire]	TBD
[Examination Request at the time of Filing (Invention Department)]		Not desired	
[Department Comment]	Particularly effective at the time of cell miniaturization		

■ Patent Staff Filling Space ■

[Receipt Number]	0290375 1	[Date of Receipt]			
[Filing Type]	Normal Filing	[Detailed Classification]			
[Own company/ Other company Classification]	Own company filing	[Original Classification]	First Count ry	[Filing Procedure Classification]	Own company management
[Title (IP Dept.)]	Manufacturing Method of Solid-State Imaging Device				
[Summary of Invention (IP Department)]	<p>As to a channel stop section which is used for partitioning off a pixel section in a solid-state imaging device, a conventional structure is of the structure that P type impurities are formed by identical energy, whereas in this invention, that structure is changed to another structure that energy is changed and ion implantation is carried out several times, so that it is possible to reduce a smear component which occurs due to a pixel peripheral surface side, and to suppress the color mixture phenomenon that adjacent pixel and photo-electrically converted electric charges are mixed. In addition, by changing an area to which ion implantation is applied with each energy, it is possible to suppress the above-described phenomenon without narrowing a pixel area. It is the invention.</p>				
[Free Keyword]					
[JK Keyword]					

[Described Content Evaluation]	Class 1 : Within Regulation			
[Evaluation Comment]				
[Network Company]	SNC SNC	[Company]	NSN1 NSN1	
[Group in charge]	GR GR/Semiconductor Fundamental Device Technology GP			
[Person in charge]	110221 Kyoichi DANTOKO			
[Importance Level Evaluation]	Acceptance Period 0203	Region Classification	Acceptance/Basic Handling Staff KL	Handling Staff kl
[4 Laws]	Patent	[Examination Request at the time of Filing (IP Department)]	No	
[Number of Claims]		[Number of Actual Inventions]	[Request Rank]	B2
[Office]	ML00 NODA Patent Office			
[Writer]	ML02 Osamu GAMON			
[Office Request Classification]	Filing Request	[Due Date]		
[Request Content]	There is a correction. Please FAX before going through procedure. We will confirm.			

•Final Disposal

Disposal Name	Relevant Information
Filing	Filing Number : 2002330150 Filing Date : 2002.11.14
[Date of Decision]	 [Reason of Decision]

•Child Matter

No	Receipt Number	Final Approval
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•Applicant

No	Company Name	In charge of Handling	Quota	Detail Input
		Classification		
1	000218 Sony Corporation	In charge of Handling	100%	Company Name : Representative Name : Postal Code : Address : Contact Point Tel : Remark :
		Right Holder (Applicant)		

•Domestic Priority Filing

No	Number Type	4 Laws	Number
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•Original Invention (Division Information)

Number Type	4 Laws	Number
	Not specified	

•Relevant Invention

No	Number Type	Country	4 Laws	Number	Type
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•Comment

[An inventor should make a copy of this paper and keeps it for himself/herself.]

[INVENTION REPORT (2)]

[Point of Invention]

This is a portion which becomes a column of [Scope of Claim for Patent] (Claims) in a specification of an application. When there are a plurality of points of an invention (claims), please write all of them with addition of items 1, 2, 3,

-
1. A channel stop structure in which multiple-stage implantation is carried out between vertical direction pixels, by changing energy.
 2. A channel stop structure in which multiple-stage implantation is carried out between horizontal direction pixels and a vertical transfer section.
 3. A channel stop structure in which ion implantation is carried out by changing a size with respect to each energy for channel stop.
 4. A channel stop structure in which ion implantation is carried out by changing P type impurity concentration at each energy.

[Prior Art and its Problem]

This is a portion which becomes a column of [Prior Art] in the specification of the application. Please write prior art and its drawback by citing patent publications, documents etc. as far as possible.

By the matter that a pixel size becomes smaller in an imaging device, a space between a vertical direction pixel and a horizontal direction pixel is narrowed, and in case of a conventional channel stop structure, there occurs the phenomenon that electric charges, into which received light is photo-electrically converted, are mixed with adjacent pixels (hereinafter, called as color mixture phenomenon). In order to prevent the phenomenon, there is need to heighten energy for channel stop, but when energy is heightened to carry out ion implantation, it leads to deterioration of a smear phenomenon due to a surface side.

In addition, by the matter that energy is heightened to carry out ion implantation, it becomes easy to occur diffusion of P type impurities, so that an electric charge storage area is narrowed and lowering of sensitivity and lowering of saturation signal quantity are brought about.

[INVENTION REPORT (3)]

[Concrete Explanation of Invention]

This is a portion which becomes a column of [Embodiment] in the specification of the application. Please explain in detail in accordance with the following procedures.

1. Please write an embodiment (apparatus/system in which the invention is used and entirety of a substantial section) which you believe is the best in order to realize this invention
2. Please write structures, operations, workings of substantial sections of the invention in detail as far as possible.
3. Please write modification examples of the invention as many as possible.

Note 1: Please write drawings, graphs, flow charts, etc. with reference numbers on attached separate papers, and please write explanations over citing the reference numbers.

Note 2: In case that there are technical reports etc., please actively make use of them for supplement of the explanations.

One example of a cross section of a structure of an imaging device sensor section is shown in Fig.1 (cross section in a

vertical direction), Fig.2 (cross section in a horizontal direction).

Normally, there is a possibility that, by expansion of an electric charge storage section (14) in a vertical direction (Fig.1), a space between pixels is narrowed and (15), in which there is no channel stop portion between pixels or ion implantation is applied only to its surface, is overlapped with an adjacent pixel to bring about a color mixture phenomenon. In addition, in a horizontal direction (Fig.2), in the same manner, there is a possibility that, by expansion of an electric charge storage section (24), (25), in which ion implantation is applied only to its surface, is overlapped with an adjacent pixel to bring about a color mixture phenomenon.

In order to suppress the color mixture phenomenon, there is need to apply ion implantation of P type impurities to a channel stop portion, deeply in a bulk depth direction, by increasing energy.

In case that ion implantation is simply applied deeply in a bulk depth direction, concentration of P type impurities on a surface side for suppressing a smear component which occurs on a surface, becomes thinner, and it becomes easy to occur the smear phenomenon.

A structure of applying ion implantation of P type impurities to horizontal direction and vertical direction channel stop

portions on multiple stages by changing energy, in order to suppress the smear component on the surface side and to suppress the color mixture phenomenon.

In addition, such a structure that, on the occasion of carrying out ion implantation on multiple stages, energy is heightened as represented by Fig.3, and thereby, an area of a portion to which ion implantation is applied is narrowed, and an area in which diffusion occurs at a deep portion in a depth direction is narrowed as much as possible, so as not to narrow a storage area.

As described above, by configuring the multiple stage channel stop portion, an advantage of suppressing a Qknee phenomenon which is brought about by increase of photo-electrically converted electric charges is expected, besides suppression of the smear component on the surface side and suppression of the color mixture phenomenon with an adjacent pixel.

[INVENTION REPORT (4)]

[Concrete Explanation of Invention] (continuation)

[Advantage of Invention]

This is a portion which becomes a column of [Advantage of the Invention] in the specification of the application. Please write advantages of the invention, which are predicted, as many as possible.

There is an advantage of preventing the color mixture phenomenon that photo-electrically converted electric charges are mixed with adjacent pixels, by carrying out multiple stage ion implantation, with changing energy of a channel stop between vertical direction pixels and a channel stop between a horizontal direction electric charge storage section and a vertical transfer section.

An advantage of preventing the color mixture phenomenon without narrowing an electric charge storage area and without lowering sensitivity and saturation signal quantity, by

reducing a size of ion implantation by high energy.

An advantage of reducing fluctuation of an overflow barrier at the time that electric charges were stored and preventing Qknee, by applying ion implantation to a channel stop with high energy.

An advantage of suppressing a smear phenomenon due to a surface side and a smear phenomenon due to an inside of a bulk, by realizing the configuration that ion implantation is applied to a channel stop between a horizontal electric charge storage section and a vertical transfer section by changing energy.

[When a paper space is not enough, please make use of an arbitrary paper such as a report writing paper, and write in detail as far as possible.]

[INVENTION REPORT (5)]

[Drawing]

As a general rule, please make use of this drawing writing paper. In this regard, however, if there is an existing drawing such as a design drawing, a CAD drawing, and a specification sheet, there is no problem to make use of it. In addition, there is also no problem to make use of it together with this drawing writing paper.

[Fig.1]

[Fig.2]

[When a paper space is not enough, please make use of an arbitrary paper such as a report writing paper, and write in detail as far as possible.]

[Fig.3]

発明のポイント

出願明細書中の **特許請求の範囲** (クレーム)の欄となるところです。発明のポイント (クレーム) が複数有るときには、1、2、3、…の項目を付してその全てをお書き下さい。

1. 垂直方向画素間にエネルギーを変えて多段に打つチャネルストップ構造
2. 水平方向画素と垂直転送部間にエネルギーを変えて多段に打つチャネルストップ構造
3. チャネルストップのエネルギーごとにサイズを変えてイオン注入するチャネルストップ構造
4. 各エネルギーのP型不純物濃度を変えてイオン注入するチャネルストップ構造

従来技術とその問題点

出願明細書中の **従来技術** の欄となるところです。従来技術とその欠点を特許公報、文献等をできるだけ引用して書いて下さい。

撮像素子における画素サイズが小さくなることにより、垂直方向及び水平方向の画素間が狭まり、受光し光電変換された電荷が従来のチャネルストップの構造であれば、隣接画素へ混ざる現象(以下、混色現象と呼ぶ)が起きる。その現象を防止するためにはチャネルストップのエネルギーを高くする必要があるが、エネルギーを高くしてイオン注入をすると、表面側起因のスミア現象の悪化に繋がる。

また、エネルギーを高くしてイオン注入することにより、P型不純物の拡散が起きやすくなり、電荷蓄積領域を狭め、感度の低下、飽和信号量の低下を引き起こす。

発明の具体的説明

出願明細書中の **実施例** の欄となるところです。以下の手順に従って詳細に説明して下さい。

1. この発明を実現するのに、あなたが最良と信じる実施態様（発明が使用される装置・システム及び要部の全体）を書いて下さい。
2. その発明の要部の構成、動作、作用をできるだけ詳細に書いて下さい。
3. その発明の変形例をできるだけ沢山書いて下さい。

注1：図面、グラフ、フローチャート等は別紙に参照番号を付けて描き、説明はその参照番号を引用しながら書いて下さい。

注2：技術レポート等がある場合には、説明の補充に積極的に利用して下さい。

撮像素子センサ部の構造の断面の一例を図1(垂直方向の断面)、図2(水平方向の断面)に示す。

通常、垂直方向(図1)において電荷蓄積部(14)の広がりによって、画素間が狭く画素間のチャンネルストップ部が無いあるいは表面のみにしかイオン注入されていない(15)と隣接画素と重なりを持ち、混色現象を引き起こす可能性がある。また水平方向(図2)においても同様に、電荷蓄積部(24)の広がりによって、チャンネルストップ部が表面のみにしかイオン注入されていない(25)と隣接画素と重なりを持ち、混色現象を引き起こす可能性がある。

その混色現象を抑えるため、チャンネルストップ部にP型不純物をエネルギーを上げバルク深さ方向深くにイオン注入する必要がある。

バルク深さ方向深くにイオン注入するのみであると、表面で起きるスミア成分を抑える表面側のP型不純物の濃度が薄くなり、スミア現象が起きやすくなる。

表面側のスミア成分を抑え且つ混色現象を抑えるため、水平方向及び垂直方向のチャンネルストップ部にエネルギーを変え多段でP型不純物をイオン注入する構造。

また、その多段でイオン注入する際に、図3に代表されるようにエネルギーを高くしてイオン注入する部分の面積を狭め、深さ方向深くにおいて拡散する領域を極力狭め、蓄積領域を狭めないようにする構造。

また、その多段でイオン注入する際に、エネルギーを高くしてイオン注入する部分の濃度を薄くし、深さ方向深くにおいて拡散する領域を極力狭め、蓄積領域を狭めないようにする構造。

上記のようにチャンネルストップ部を多段で構成することにより、表面側のスミア成分の抑制、隣接画素との混色現象の抑制の他に、光電変換された電荷が増加することにより引き起こされるQknee現象を抑制する効果も期待される。

発明の効果

出願明細書中の 発明の効果 の欄となるところです。予測される発明の効果をできるだけ沢山書いて下さい。

垂直方向の画素間チャンネルストップ及び水平方向電荷蓄積部と垂直転送部間のチャンネルストップのエネルギーを変え多段に打つことにより、光電変換された電荷が隣接画素へ混ざる混色現象を防ぐ効果がある。

高エネルギーでイオン注入するサイズを小さくすることにより、電荷蓄積領域を狭めず、感度、飽和信号量の低下なく混色現象を防ぐ効果。

チャンネルストップを高エネルギーでイオン注入することにより、電荷が蓄積された時のオーバーフローバリアの変動を小さくし、Qkneeを抑制する効果。

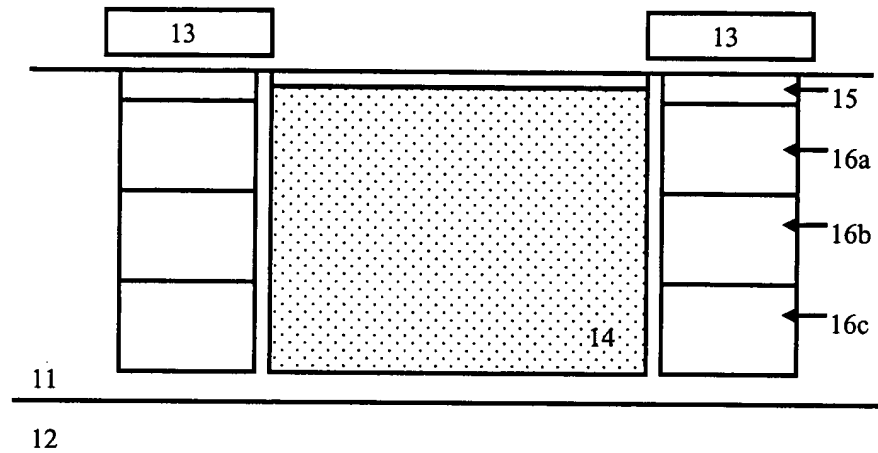
水平方向電荷蓄積部と垂直転送部間のチャンネルストップをエネルギーを変えて打つ構造にすることにより、表面側起因のスミア現象とバルク中起因のスミア現象を抑制する効果。

紙面が不足のときは、レポート用紙等の任意の用紙を利用してできるだけ詳細に書いて下さい。

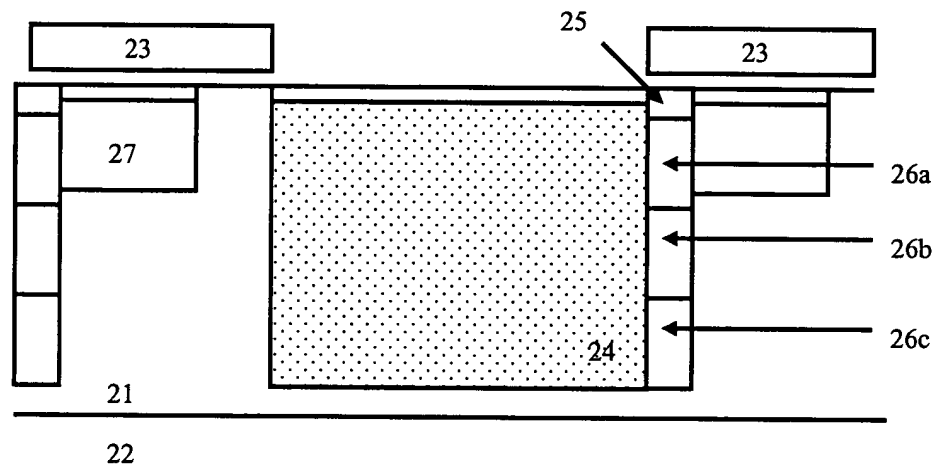


原則として本図面用紙をご利用下さい。但し、設計図、CAD図、仕様書等の既存図面が有ればそれを利用してもかまいません。又本図面用紙と併用してもかまいません。

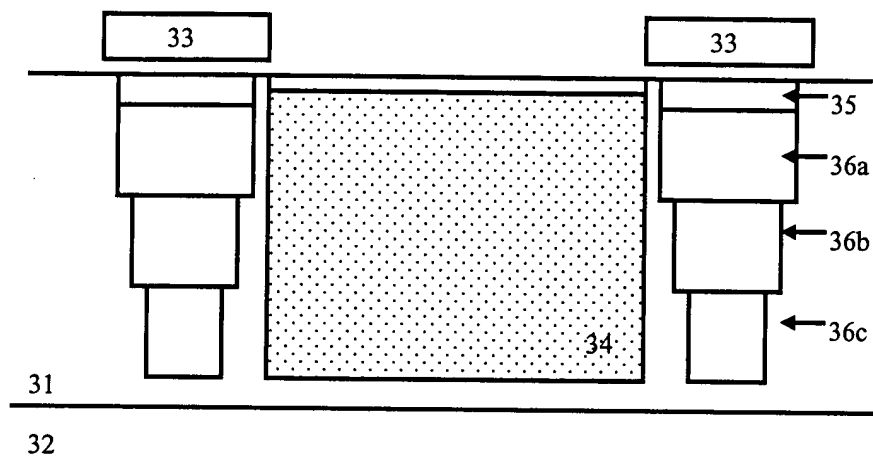
【図1】

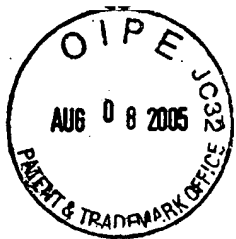


【図2】



【図 3】





CERTIFICATION

I, Isamu Kitade, ARK MORI Bldg., 13F, No. 12-32, Akasaka 1-chome, Minato-ku, Tokyo, Japan, do hereby certify that I am conversant with the English and Japanese languages and am a competent translator thereof, and I further certify that to the best of my knowledge and belief the attached English translation is a true and correct translation made by me of the "Invention Report" (Proposal No. [REDACTED]) dated [REDACTED] by the Inventor, Kiyoshi Hirata, corresponding to U.S. Serial Number 10/705,552 filed November 11, 2003, titled "SOLID STATE IMAGING DEVICE AND METHOD FOR MANUFACTURING THE SAME".

Signed this on the 11th day of July, 2005

Isamu Kitade

Isamu Kitade